Bilkent University
CS-224 Lab 6
Preliminary Work

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Part 1

1.1

NOTE: Main memory = **4GB** → Physical Address Structure = **32 bits** in each case.

No	Cache Size	N-way cache	Word Size	Block size	No. of Sets	Tag Size	Index Size	Word Block Offset	Byte Offset	Block Replacement Policy Needed (Yes/No)
1	128	1	32	4	8192	15	13	2	2	No
2	128	4	32	16	512	17	9	4	2	Yes
3	128	Full	32	16	1	26	0	4	2	Yes
4	256	2	64	8	2048	15	11	3	3	Yes
5	256	4	64	32	256	16	8	5	3	Yes
6	256	Full	16	16	1	27	0	4	1	Yes

1.2

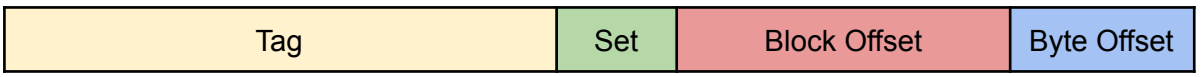
Memory Address Accessed (hex)	**Set No.**	**Hit (yes/no)**
00 00 20 24	00	No
00 00 20 42	00	No
00 00 20 68	01	No
00 00 20 04	00	No
00 00 20 0C	01	No
00 00 20 4C	01	No

1.3

Memory Address Accessed (hex)	**Set No.**	**Hit (yes/no)**
00 00 00 2C	01	No
00 00 00 48	01	No
00 00 00 44	00	No
00 00 00 0C	01	No
00 00 00 04	00	No
00 00 00 0C	01	Yes

1.4

a) Physical Address Structure



25 Bits **1 Bit** **5 Bits** **1 Bit**

b) Size of a Block in Bits (Data Area + Overheads (Tag, V, D, U))

NOTE: In textbook U for LRU policy appears on each set once, however in the pdf file submitted with this Lab files show for true LRU replacement each way, therefore each block has U area.

Data Area = 16*32 = 512 Bits
Tag = 25 Bits
Valid Bit = 1 Bit
Dirty Bit = 1 Bit
U ($\log_2 N$) = 3 Bits
Size of Block = 542 Bits

c) Size of a Set and SRAM in Bits

Set Size = N * (Size of Block)
N (Number of Ways) = 8
Size of Block = 542 Bits
Size of Set = 4336 Bits

Total SRAM Size = (Set Amount) * (Size of Set)
Size of SRAM = 8672 Bits

d) Random Replacement Policy's Effect on SRAM Size

The U value which is used for choosing the block to be evicted in LRU Replacement policy will be gone if the policy is changed to Random Replacement. Therefore, the bits in U ($\log_2 N$ = 3 bits) for each way/block from each set will be removed. Hence the SRAM size will be smaller.

SRAM Size = N*(Size of Block)*(Set Amount) → Decrease = 8*3*2 = 48 Bits.
Therefore **SRAM size will decrease 48 Bits.** New size of SRAM = 8624 Bits.